AFOSR Overview

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Air Force Office of Scientific Rese

Air Force Office of Scientific Research

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Air Force Research Laboratory

Directed Energy

AFOSR

Materials & Manufacturing

Space Vehicles

Human Effectiveness

Munitions

Sensors

Air Vehicles

Propulsion

Information
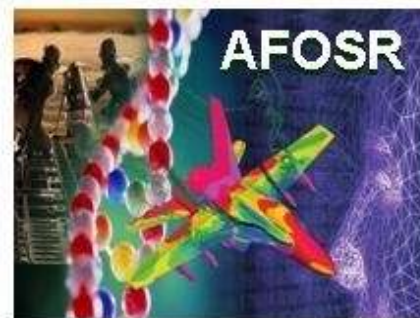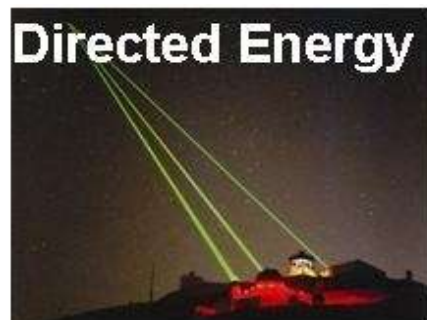
The Air Force's Corporate Research and Development

AFOSR Vision & Mission

Vision: *The U.S. Air Force dominates air, space, and cyber through revolutionary basic research.*

Mission: *We discover, shape, and champion basic science that profoundly impacts the future Air Force.*

- **ID Breakthrough Research Opportunities – Here & Abroad**

- **Foster Revolutionary Basic Research for Air Force Needs**

- **Transition Technologies to DoD and Industry**

TODAY'S BREAKTHROUGH SCIENCE FOR TOMORROW'S AIR FORCE

AFOSR Roles
AF Basic Research Manager

- **Identify Breakthrough Research Opportunities – Here & Abroad**
  - **Regular interactions with leading scientists and engineers**
  - **Liaison offices in Europe, Asia, Latin America**
  - **179 short-term foreign visitors; 28 personnel exchanges**
  - **93 summer faculty; 55 postdocs/senior scientists at AFRL**

- **Foster Revolutionary Basic Research for Air Force Needs**
  - **1162 extramural research grants at 190 U.S. universities**
  - **246 intramural research projects at AFRL, USAFA, AFIT**
  - **179 STTR small business - university contracts**
  - **565 fellowships; 1574 grad students, 530 post-docs on grants**

- **Transition Technologies to DOD and Industry**
  - **58 workshops conducted; 210 conferences co-sponsored**
  - **686 funded transitions in FY08 data call (64% response rate)**

Basic Research Focus Areas

Aerospace, Chemical & Materials Sciences (RSA)

- Aero-Structure Interactions and Control
- Energy, Power, and Propulsion
- Complex Materials and Structures
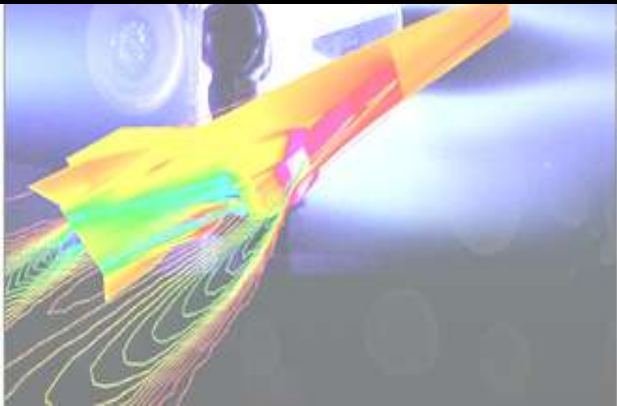
Physics & Electronics (RSE)

- Complex Electronics and Fundamental Quantum Processes
- Plasma Physics and High Energy Density Nonequilibrium Processes
- Optics, Electro-magnetics, Communication, and Signal Processing
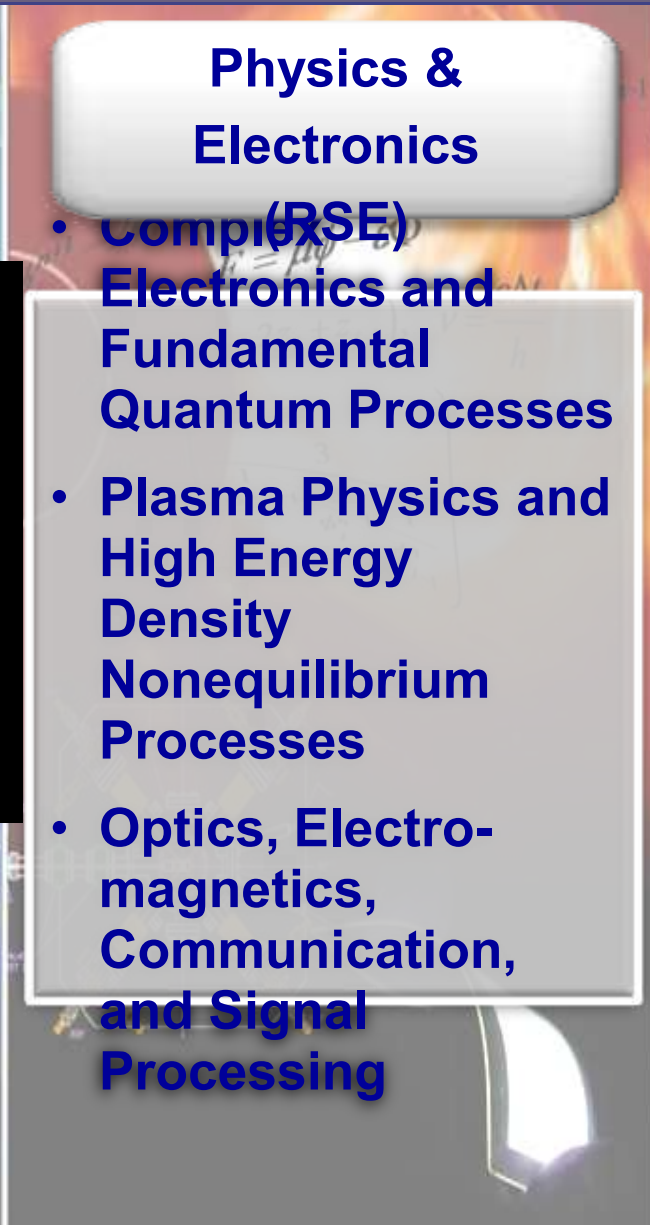
Math, Information & Life Sciences (RSL)

- Information and Complex Networks
- Decision Making
- Dynamical Systems, Optimization, and Control
- Natural Materials and Systems
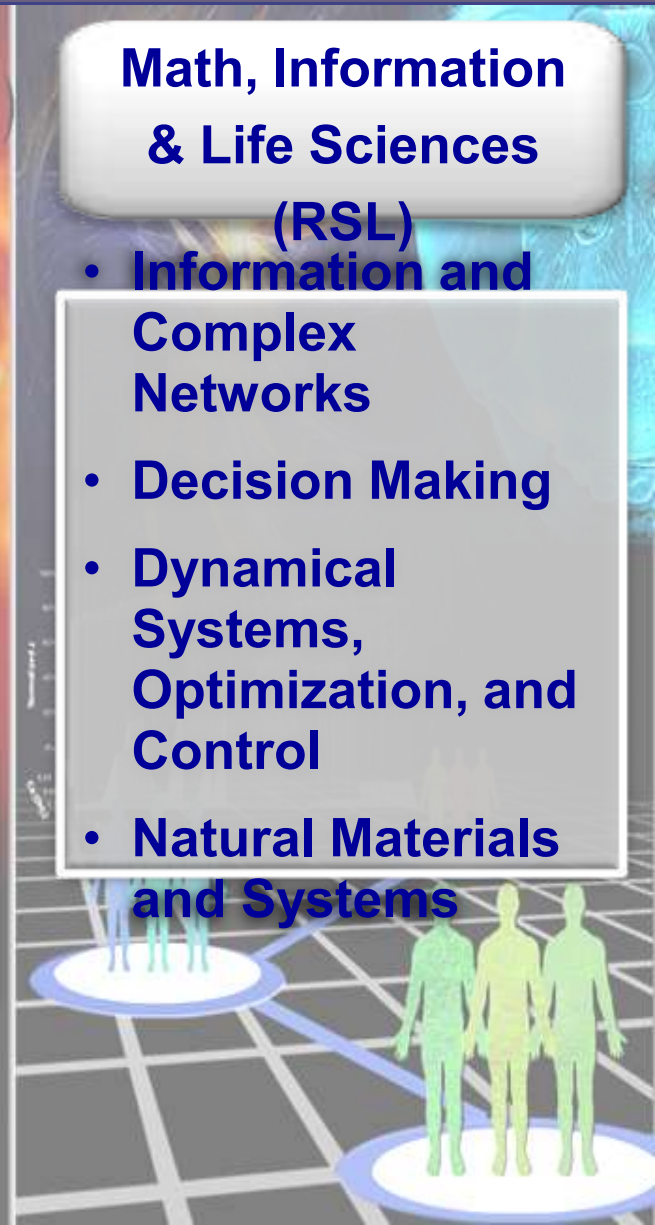
AFOSR Supports University Individual Investigators

- **Goals**

  - **Provide revolutionary scientific breakthroughs to maintain military air, space, and information superiority**

  - **Build collaborations between AFRL and universities**

- **General Process**

  - **Researchers submit white papers to AFOSR program managers**

  - **Promising white papers lead to request for full proposals**

  - **Proposals merit reviewed for *excellence* and *relevance***

  - **Individual grants awarded for up to 5-years in duration**

- **Broad Agency Announcement (BAA) open at all times to innovative ideas http://www.afosr.af.mil**

AFOSR Supports Multidisciplinary University Research (MURI)

- **Achieve significant scientific advances**
  - **Capture attention of top researchers**
  - **Build on results of individual-researcher grants**
  - **Encourage multidisciplinary collaboration**
- **Up to $1.5M/yr for five years**
- **Typically 8 research topics per Service**
  - **Occasional joint topics**
  - **One or two awards per topic**
- **Currently there are 61 AFOSR MURI Projects (FY05-09)**
  - **Funded 15 projects in FY09**

Small Business (University-Industry) Collaborations (STTR)

- **Small Business Technology Transfer (STTR) program provides up to $850,000 for early-stage R&D directly to small companies working cooperatively with research institutions (http://www.acq.osd.mil/sadbu/sbir/)**

  - Company must be U.S. for-profit small business; 500 or less employees

  - Research institution must be a U.S. college or university, FFRDC, or non-profit research institution

  - Principal investigator must be employed at small business or research institution

- **Air Force plans to support 30 topics for FY10**

  - July 20, 2010:   Solicitation issued for public release

  - August 17, 2010: DoD began accepting proposals

  - September 15, 2010: Deadline for receipt of proposals

  - February 3, 2011: Contracts awarded

AFOSR Supports Tomorrow's S&Es

- **National Defense Science and Engineering Graduate Fellowship (NDSEG)**
  - ✓ **Full tuition assistance + $31K/per year stipend**
  - ✓ **Fellows do not incur any service obligation**
  - ✓ **Supports over 550 PhD-track graduate students**
  - ✓ **More info: http://www.asee.org/ndseg**

- **Awards to Stimulate and Support Undergraduate Research Experience (ASSURE)**
  - ✓ **Provide undergraduates with research opportunities in S&E fields of DoD interest**
  - ✓ **Supports over 500 undergraduate students during summer months**
  - ✓ **More info: http://www.afosr.af.mil**

- **Presidential Early Career Award for Scientists & Engineers (PECASE)**
  - ✓ **Recognize outstanding young S&Es in AF interest areas**
  - ✓ **5-year awards $200K/year (up from $100K)**

- **Young Investigator Program (YIP)**
  - ✓ **Develop long-term relationships with leading junior PIs**
  - ✓ **127 YIP awards since FY07; 38 awards in FY10**
  - ✓ **Awards up to 5 years at $120K/yr beginning in FY09**
 - ✓ **Must have received PhD in the last five years**
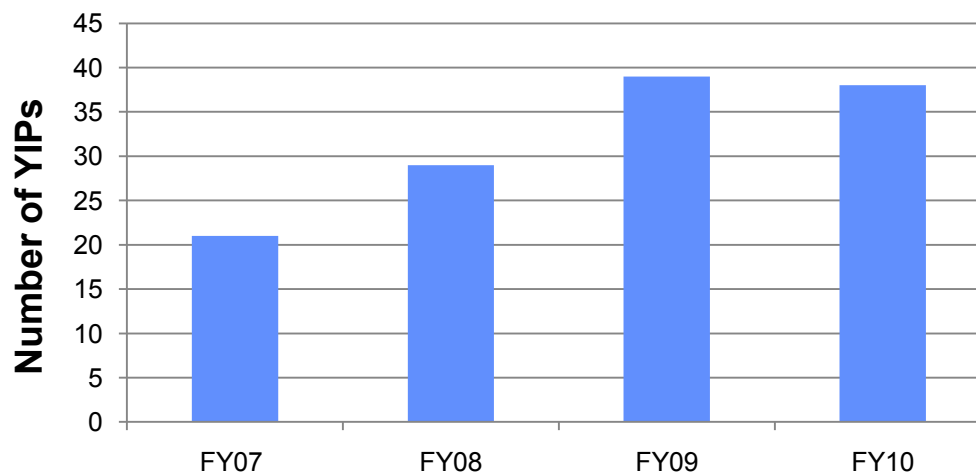
National Security Science and Engineering Faculty Fellowships

- **DDR&E program, managed by AFOSR**
- **Objectives**
  - **Excellent unclassified basic research on topics of interest to DoD**
  - **Long-term relationships with outstanding faculty and students**
  - **Familiarity with DoD missions, technologies, and challenges**
  - **Cadre of technical experts for DoD advisory groups**
- **Award Information (Eleven awards in FY10)**
  - **Single-investigator awards up to $850K/yr for up to 5 years**
  - **Open to faculty at US doctoral degree-granting institutions**
  - **US citizens and permanent residents are eligible to apply**
- **Application process (more info at http://nsseff.ida.org/)**
  - **Letter of intent to nominate from home institution**
  - **Formal nomination letter and white paper**
  - **Full proposal and oral presentation (by invitation only)**

DoD Basic Research Enterprise
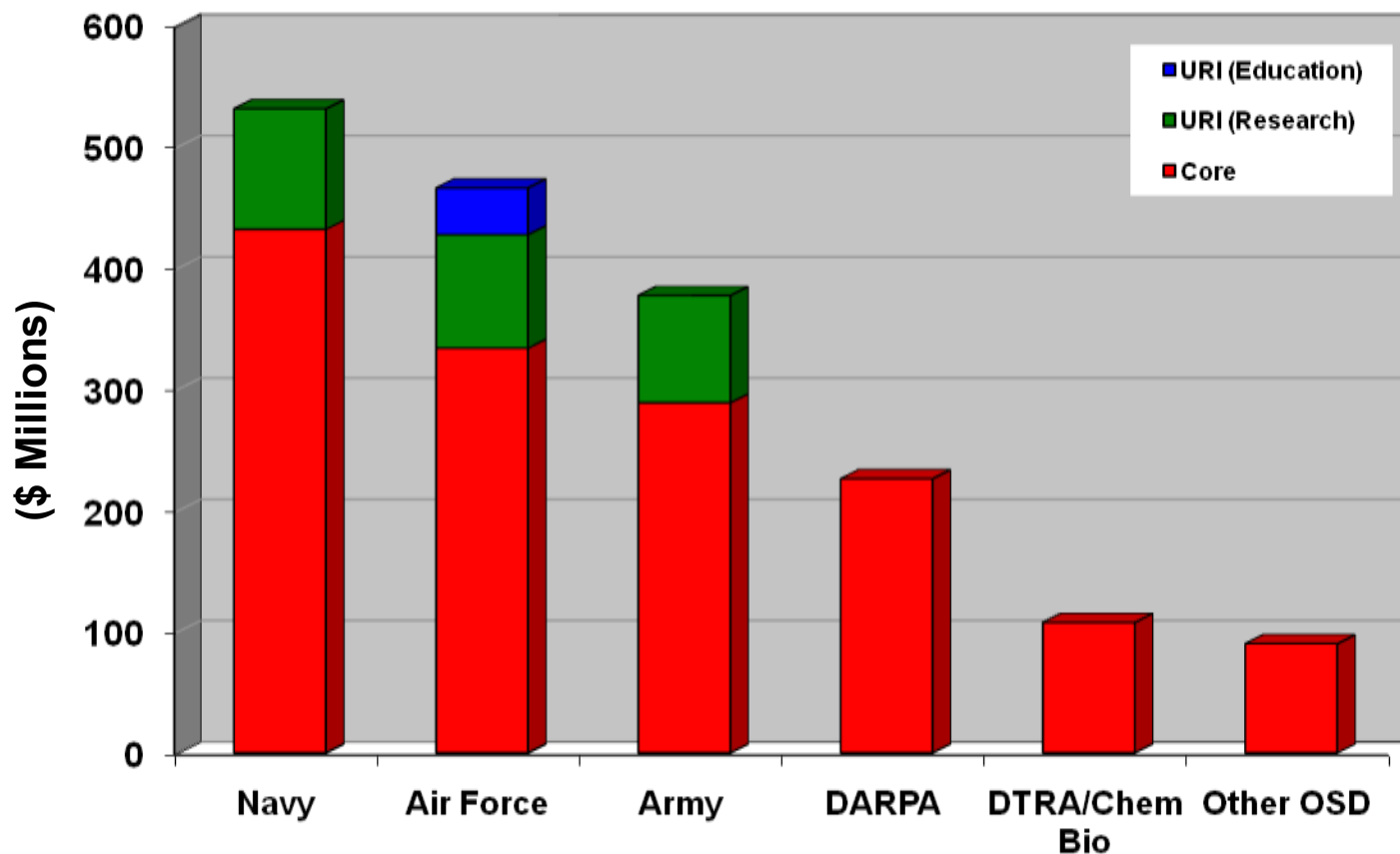
DoD Total FY10 Basic Research Budget = $1.8B

AFOSR

Collective Behavior and Socio-Cultural Modeling

22 March 2009

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- **Basic social science often not understood**
  - **Collective models less developed than individual models**
  - **Non-rational behavior (e.g., emotions, beliefs, & values) less understood than rationale behavior**
- **Meso-level less studied and data harder to find**
- **No standard definitions/taxonomy/ontology for culture; no unified model or theory - embedded in specific social systems, multiple disciplines, but no common language or notation**
- **DATA ISSUES: Reliance on observational data from multiple sources/biases: Diverse, incomplete, multi-lingual, inconsistent coding, non-current, estimated, codes dropped/added, mixed data including parametric and non-parametric data, survey data limited to stated vs. revealed preferences (semantic reports).**
  - **Automatically extracted data particularly subject to bias and not easily verifiable - sampling bias, echo, etc.**

- Data often sparse for areas of real interest - limited empirical culture data: field work necessary when data may be manipulated – allows higher standards of verification

- How universal is the dataset: e.g., do gangs share common characteristics with terrorist networks, do the "troubles" in Northern Ireland share commonalities with Middle East terrorism, etc.

- How robust are the models to errors in the data?

- Relevant experimental data very sparse, simplified scenarios & limited choice of laboratory subjects

  – Are on-line games generalizable to real world behavior?

- Reliance on descriptive studies subject to sampling error, random misclassification, selection/measurement bias, & confounding

- Multiple possible independent & dependent variables. Is there continuity of the variables?

- **Causal structure is unknown: Complex, multi-factorial causation is the rule, bi-directional causation possible**

- **What is the optimum scale at which to model collective behavior?**

- **Multiple possible modeling approaches**

  - **Dynamic/temporal dimension (order of actions) & spatial dimensions (geography) poorly captured by existing models. "When" is difficult to predict.**

- **Multi-level problem: national>regional>local>individual>brain>amygdala>etc**

- **Computational intractability – Cumulative uncertainty - Multiple possible actions and outcomes (dependent variables) - n possible actions = 2^n possible worlds - doesn't include spatial or temporal dimension)**

- **Model assessment (?" V&V), model generalizability**

1. **DoD Funds New Views on Conflict With its First Minerva Grants (<u>Science</u>, Vol. 317, p-1039-40, 24 August 2007)**

2. **Sacred values - implications for negotiation, Atran (<u>Science</u>, Vol 317, p-1039-40, 24 August 2007)**

3. **"What Can Virtual Worlds and Games Do for National Security?", Subrahmanian (<u>Science</u>, VOL 326, 27 NOV 2009:1201-2102).**

The Computer as a Roadmap to Unknowable Territory(<u>The Washington Post</u>, 16 February 2009)

- **Atran, 25 Jan 2009: "Words to End War"**

- **Atran, 13 Dec 2009: "To Beat Al Qaeda Look to the East"**

Building a Community of Practice

- **Fragmented research community - social Science Stovepipes: "inventing their own toothbrushes (theories)"**

- **Barriers at Universities to Multi-disciplinary Research:**
  - **Dearth of graduate students and training programs**
  - **Many non-academic proposals**
  - **Few young investigators**

- **Creating a community of practice:**
  - **Interdisciplinary research**
  - **International participation**
  - **"3rd International Workshop on Social Computing, Behavioral Modeling, and Prediction". 29-31 Mar 10: # 354 registered**

- **Insufficient AFRL intellectual capital in social science (except Psychology)**

Postsecondary Doctoral Faculty

- 85
- 54,100
- 106,500

- **■ Social science**
- **■ Biology/ health**
- **■ Physical sciences**